

DISTRIBUTED POWER GENERATION

[0001] The present invention relates to distributed power generation and more particularly to methods of operating distribution power generation systems in relation to provision of a number of electrical power generation sources providing power to a number of electrical power loads through a distribution network.

[0002] It is known to provide distributed power generation systems in which a number of power sources such as main line power generation through major power stations as well as localised generation are combined in a grid to provide the requirements in terms of electrical power consumption to a number of loads. Such distributed power generation systems and methods of operating such systems provide security of supply as well as greater flexibility to meet varying electrical load demands upon a whole network. It will be understood an alternative would be to simply provide one electrical power station for all possible load requirements which clearly would be impractical. Nevertheless, all the electrical power sources and loads must be synchronised upon the system for efficiency.

[0003] Current distributed power generation systems can be considered to operate in one of the following manners.

[0004] a) The distribution system generally trips off the whole network during fault conditions or frequency/voltage excursions. In such circumstances the generators provide little security of supply benefit for local loads since the whole will go off line when there is a problem in the main power distribution network.

[0005] b) By provision of emergency generators that generally sit idle but start automatically should there be a variance from a known power criteria in order to meet a predefined local demand via a changeover switch during power outages from the main distribution network. Such emergency generators provide security of supply to the defined load although there will clearly be a brief delay when the emergency generator starts and until the changeover switch is thrown. Such emergency generators define inflexible power islands which combine power sources or an emergency generator as a sole power source for a fixed number of power loads.

[0006] c) By provision of generators which are designed only to operate in island conditions it is possible to create by use of portable generators and generators connected to electrical isolator systems essentially isolated or island local groupings of a power source or sources and power loads substantially matched across the local group or island.

[0007] d) In some maritime, military and disaster relief situations generators can be defined which attempt to remain essentially on-line at all times, in such circumstances they are potentially connected together in a multi-generator island but will typically operate on a relatively simple power frequency droop curve with little or no autonomous intelligence for matching.

[0008] Problems occur with all the above approaches in that none attempt to fully utilise the reliability of a local generator and the benefits of attaching that generator to a wider network. These benefits include better power system stability in terms of frequency, voltage etc., more flexibility and power sharing between generators allowing individual generator maintenance to take place while power is supplied by other

loads and better economic performance by allowing power sharing between generators based upon electrical demand, network constraints, fuel costs and availability of a particular generator at any particular time.

[0009] It will be understood that a wire network inevitably will become unreliable the larger that network becomes due to the number of potential failures or power outages which may occur. However transition to a local power system or group containing at least one electrical power source in the form of a generator itself can produce a so-called islanded state in order to provide for local electrical power demands whilst the wider parent network is unavailable. It will be understood that this is inherently the purposes of an emergency generator as a power source but normally there is a delay in the generator start up and fixed load configuration requirements for such generators limit their effectiveness. If there is a so-called uninterruptible power supply (UPS) requirement it is normally necessary to add to the emergency generator an expensive battery or other storage device e.g. flywheel to act to provide emergency power during the period of emergency generator start up. By such an approach it will be understood that there is an uninterruptible power supply even over the potentially few minutes until an appropriate emergency generator is fully on-line and providing electrical power to a local group distribution network. However it will also be understood that neither emergency generators nor UPS systems present optimal return on investment since most of the apparatus and equipment is idle for most of its life.

[0010] Recent increases in the utilisation of distributed generation has opened up the possibility of greater security of supply by allowing individual generators in a local group to operate in a so-called islanded mode when they act in a similar fashion but generally more effective manner of an emergency generator or UPS system.

[0011] Attached FIG. 1 provides an illustration of a typical distributed power generation system in which a controller 1 is arranged to monitor through external controls local current CT and voltage VT at various nodes within the system. The controller 1 will typically also monitor through appropriate instrumentation and sensor signals from such devices as tachometers, condition and monitoring signals and other criteria with regard to distributed network operation. The inputs to the controller 1 enable the controller 1 itself to change operation of the generator or provide variations in generators at different positions or adapt or alter the electrical loads included within a local group distribution network as an electrical power island. It will be understood that the settings presented by the controller 1 may change or be updated at a predetermined regular or irregular interval typically on a second by second basis. In such circumstances it will be appreciated that the controller 1 has control and influence over a number of devices within dotted line 2. In the illustration this includes two breaker or contact switch elements 3, 4 as well as loads upon the local group distribution network 10, that is to say controllable loads 5 of a known nature and uncontrolled loads 6. The switch 4 enables switching of a generator 7 into the local group distribution network 10 whilst the switch 3 relates to switching a potential local group distribution network 10, or electrical power island, into the main distribution network 11.

[0012] It will be understood that the controller 1 in such circumstances sets the generator 7 output via control links dependent upon prime mover and generator type accounting for current electrical power operating conditions. The con-